Mosquito-borne illness chikungunya spreads in and around homes, disproportionately hits women

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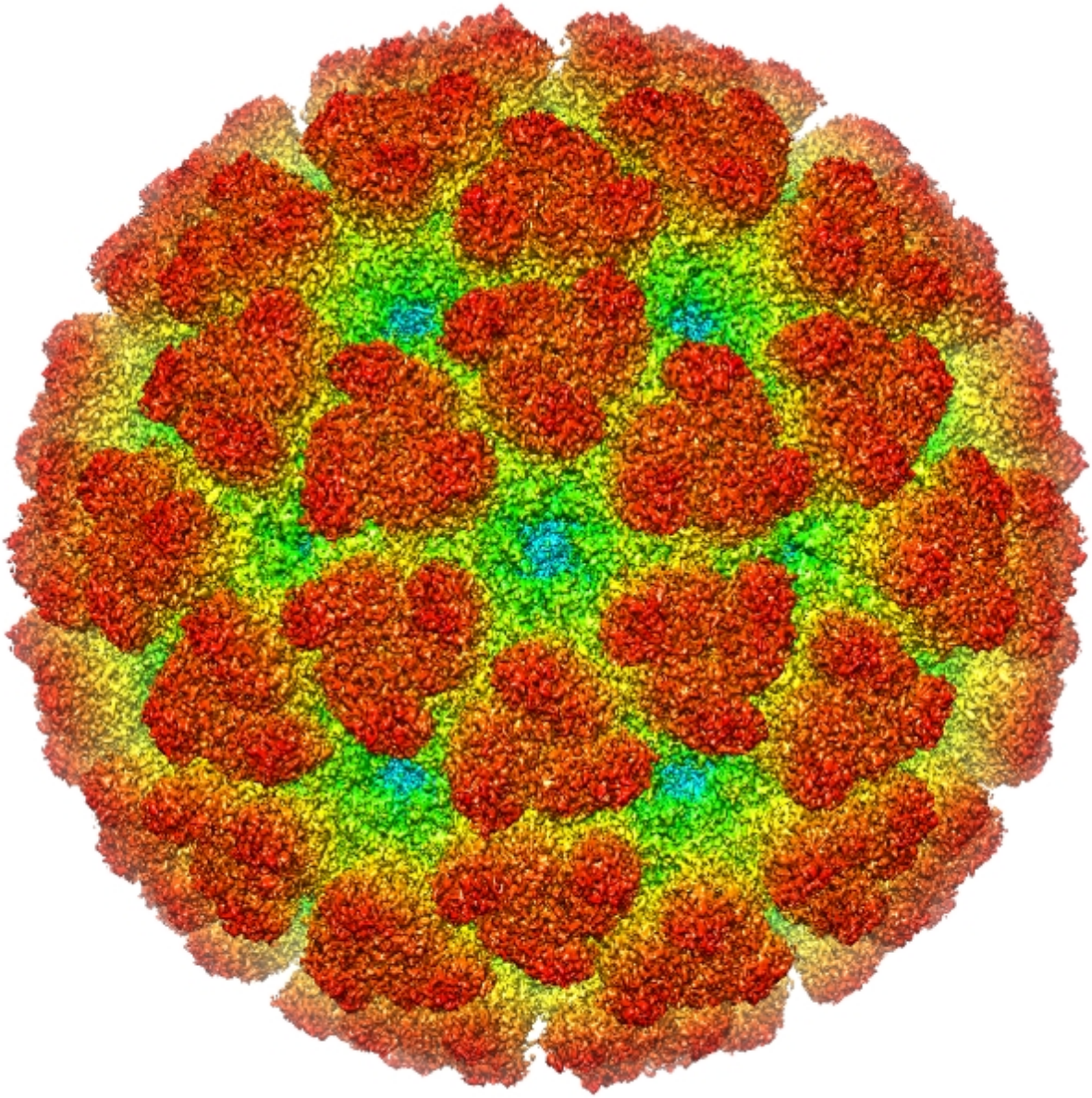

Cryoelectron microscopy reconstruction of Chikungunya virus. From EMDB entry 5577. Credit: Wikipedia

Outbreaks of the mosquito-borne disease chikungunya appear to be driven by infections centered in and around the home, with women significantly more likely to become ill, suggests new research from the Johns Hopkins Bloomberg School of Public Health, the Institut Pasteur in Paris and the International Centre for Diarrhoeal Disease Research, Bangladesh.

The findings, published Nov. 7 in the *Proceedings of the National Academy of Sciences*, offer key insights into how health officials can combat other diseases that spread the same way, including Zika. The research focuses on a small rural village in Bangladesh, but offer a new path for investigating and responding to outbreaks large and small for a variety of diseases transmitted via the Aedes mosquito, which also includes dengue and yellow fever.

"Typically when there is an outbreak, we study who is sick and try to understand why," says study leader Henrik Salje, PhD, a post-doctoral fellow in the Department of Epidemiology at the Bloomberg School and a visiting scientist at Institut Pasteur. "In this case, we not only studied those who became infected with chikungunya, but also those who avoided illness. This allowed us to determine what factors may impact who comes down with a disease and who does not - and to help us determine the best way to intervene."

For the study, researchers investigated a 2012 chikungunya outbreak in Palpara, a village 60 miles outside the Bangladeshi capital of Dhaka. The

team visited every household in the village and interviewed 1,933 individuals from 460 households. A total of 364 people (18 percent) reported having symptoms consistent with chikungunya (fever with severe joint pain or rash) between May 29 and Dec. 1, 2012.

Even though chikungunya is transmitted via mosquito - and not by coming into close contact with someone who is ill - the researchers found that more than a quarter of human cases were spread within the same household and that half of infections occurred in households less than 200 meters away, creating small clusters of disease. This was an unexpected finding, the researchers say.

Meanwhile, the researchers also looked at the movement habits of the wider Bangladeshi population and learned that women in the country spend 66 percent of their time between 8 a.m. and 8 p.m. at home while men spend 45 percent at home. Coupled with the tendency of infected mosquitoes not to travel far, this made being at home an important determinant for becoming infected during the chikungunya outbreak.

"It appears that mosquitoes are very lazy," Salje says. "They bite someone in a household and get infected with a virus and then hang around to bite someone else in the same home or very nearby. The extra time women spend in and around their home means they are at increased risk of getting sick." Overall, the researchers found that women in Palpara were 1.5 times more likely to develop chikungunya than men. The researchers also found that coils designed to repel mosquitoes did not work to prevent transmission in this region.

Ideally, knowing where outbreaks are likely to be clustered could help in slowing them, but in the case of chikungunya, Zika and several other diseases spread by the same mosquitoes, there is no vaccine, mosquito control is poor and very little treatment is available. Also hampering response in places like rural Bangladesh is the fact that few people visit

trained doctors and authorities often don't know that an outbreak has occurred until it is over.

"We don't yet have a very good toolbox for fighting these diseases," Salje says. "But once we do, this research tells us how we could trigger a response and tailor our interventions - particularly in rural communities - to those at the greatest risk, and those people are the ones who spend the most time in and around their homes."

"How social structures, space, and behaviors shape the spread of infectious diseases: chikungunya as a case study" was written by Henrik Salje, Justin Lessler, Kishor Kumar Paul, Andrew S. Azman, M. Waliur Rahman, Mahmudur Rahman, Derek Cummings, Emily Gurley and Simon Cauchemez. The researchers are from the Institut Pasteur in Paris; International Centre for Diarrhoeal Disease Research, Bangladesh; Institute of Epidemiology Disease Control & Research in Bangladesh; and the University of Florida.

More information: How social structures, space, and behaviors shape the spread of infectious diseases using chikungunya as a case study, *Proceedings of the National Academy of Sciences*, www.pnas.org/cgi/doi/10.1073/pnas.1611391113

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